CARPMAELS & RANSFORD

CHARTERED PATENT ATTORNEYS EUROPEAN PATENT ATTORNEYS TRADE MARK ATTORNEYS

TELEPHONE 020-7242 8692
FACSIMILE 020-7405 4166
WEBSITE www.carpmaels.com
E-MAIL email@carpmaels.com

43-45 BLOOMSBURY SQUARE
LONDON WC1A 2RA
AND AT MUNICH

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YOUR REF

OUR REF P043595EP/HGH/Records

29 August 2008

Dear Sirs

Re: European Patent Application No. 05719856.6
TEIJIN FIBERS LIMITED

I write to enquire when I can expect to receive the Supplementary Search Report on this application.

This is a routine reminder since I have not heard from you recently. It is NOT a request for accelerated prosecution.

Yours truly

HALLYBONE, Huw George

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AND AT MUNICH

European Patent Office
Erhardtstrasse 27
D-80469 Munich
GERMANY

YOUR REF

OUR REF P043595EP: HGH/PSB/EK

20th October 2006

Dear Sirs,

Re: European Patent Application No. 05719856.6
TEIJIN FIBERS LIMITED

In response to your communication pursuant to Rules 109 and 110 EPC, issued in connection with the above application, I enclose replacement pages 13-15, 21-24, 26-35 and 38 to replace those currently held on file.

Following translation of the original PCT application, the applicant has noticed that several of the reference signs contained within the description currently held on file are incorrect. The enclosed amended pages detail the correct reference signs which are used in the text and in three tables. Basis for these changes can be found in the original international application as filed.

Yours truly,

HALLYBONE, HUW GEORGE

Enc.

(B) are formed from a single type of fiber-forming synthetic resin or a blend of two or more fiber-forming synthetic resins. In the case of a core-in-sheath type composite fiber, two types of resins are melted, the two types of resin melts are combined in a cylindrical nozzle arranged upstream to the melt-spinning hole to form a core-in-sheath structure, and the combined melt stream is extruded through a melt spinneret having melt-spinning holes as shown in Figs. 3-(A)[a] to (F)[c], to produce composite fibers having the cross-sectional profiles as shown in Figs. 3-(D)[A] to (F)[c]. Also, in the melt spinning procedure as mentioned above, a cooling air is blown toward the resin melt filamentary streams to cool and solidify the melt streams. In this procedure, the D/L ratio of the cross-sectional profile of the resultant fibers can be controlled within the range of from 0.1 to 0.5, by appropriately controlling the flow rate of the cooling air and the location at which the cooling air flow comes into contact with the filamentary melt streams. The resultant undrawn filament yarn is drawn in air at room temperature or in hot water at a temperature of 60 to 95°C in a single stage or a plurality of stages, at a total draw ratio of 1.2 to 5.0. The drawn filament yarn is oiled with an oiling agent, is optionally crimped by using a stuffing crimper and, thereafter, is cut into a desired fiber length, to provide the staple fibers of the present invention.

The fiber having the cross-sectional profile shown in Fig. 3-(D)[A] is constituted from a fiber-forming synthetic resin for forming a core portion 11 and another fiber-forming synthetic resin for forming a sheath portion 12, to form a core-in-sheath type composite structure having three concavities. The fiber having the cross-sectional profile shown in Fig. 3-(E)[B] is formed from a core portion 11-forming synthetic resin and a sheath portion 12-forming synthetic resin different from each other into a core-in-sheath composite structure

having a single concavity. The fiber having the cross-sectional profile shown in Fig. 3-(C) is constituted from a core portion 11-forming synthetic resin and a sheath portion-forming synthetic resin into a core-in-sheath type composite structure having 8 concavities.

There is no limitation to the composition of the oiling agent usable for the above-mentioned procedures. Preferably, an oiling agent comprising 30 to 90% by mass of an alkalic metal salt of an alkylphosphoric acid having 10 to 20 carbon atoms and 10 to 70% by mass of a polydimethylsiloxane and/or a polyoxyethylene-polyoxypropylene-graft copolymerized polysiloxane, to promote the opening property of the fibers. Preferably, the oiling agent is applied at an amount of 0.01 to 5% by mass. If the application amount of the oiling agent is less than 0.01% by mass, when the resultant staple fibers are subjected to an air-laid nonwoven fabric-producing procedure, static electricity is easily generated, and if the application amount of the oiling agent is more than 5% by mass, the resultant staple fibers are easily adhered to each other to form staple fiber bundles, and thus exhibit a degraded air opening property. When the staple fibers of the present invention having the specific irregular cross-sectional profile, as the contact area of the staple fibers with each other become small, and the influence of the change in frictional property of the staple fibers due to the application of the oiling agent becomes small on the air opening property of the resultant staple fibers, the variety in means for impacting a function, for example, hydrophilicizing function, water-repellent function, antibacterial function, deodorant function or aromatic function to the fibers can be expanded.

The melt-spinning holes shown in Fig. 2-(c) and Fig. 3-(D) are used for producing conventional staple fibers (comparative) having the cross-sectional profiles as shown in Fig. 2-(C) and Fig. 3-(D). The cross-

sectional profile shown in Fig. 2-(C) is circular, and in the core-in-sheath type cross-sectional profile shown in Fig. 3-(D), a core portion 11 having a circular cross-sectional profile is arranged within a sheath portion 12 having a circular cross-sectional profile.

To produce an air-laid nonwoven fabric from the staple fibers of the present invention, a conventional method can be used. By using the staple fibers of the present invention, the air-laid nonwoven fabric having a high quality can be produced. Particularly, the number of defects which is represented by a total number of non-opened fiber bundles and fiber pills having a diameter of 5 mm or more, contained in 1 g of the resultant web, is preferably 10 or less. The term "non-opened fiber bundles" represents fiber bundles formed from the non-opened fibers bundled in parallel to each other and having a cross-sectional major axis of 1 mm or more.

When the staple fibers of the present invention are used, the number of defects generated during the production of the air-laid nonwoven fabric is extremely small, and thus a desired web can be formed with high stability.

The synthetic staple fibers of the present invention optionally contains various functional agents, for example, at least one member selected from deodorant functional agents, antibacterial functional agents, flame retardant functional agents and insect-repellent functional agents. In the staple fibers of the present invention, the functional agent may be mixed into the fiber-forming synthetic resin and preferably the functional agent is applied and fixed to the peripheral surfaces of the staple fibers.

In the conventional staple fibers for the air-laid nonwoven fabric, an increase in the application amount of the functional agent on the staple fiber surfaces, particularly in an application amount of 0.05% by mass or more, causes the air opening property of the resultant

Ten samples each having a mass of 1 g were randomly collected from 10 respective sites of the web. For each sample, the number of non-opened fiber bundles having a cross-sectional major axis of 1 mm or more) and pills having a diameter of 5 mm or more per g of the sample, was counted. The average of the total number of defects per g of the web sample was calculated. When the number of defects was 10 or less, the web passed the test.

Example 1

A high density polyethylene (HDPE) having a MFR of 20 g/10 min and a T_m of 131°C and a poly(ethylene terephthalate) (PET) vacuum dried at 120°C for 16 hours and having an intrinsic viscosity [η] of 0.61 and a T_m of 256°C were melted separately from each other by separate extruders to prepare a polyethylene melt having a temperature of 250°C and a polyester melt having a temperature of 280°C. The polyethylene melt was used as a sheath component A and the polyester melt was used as a core component B. The sheath component (A) resin melt streams and the core component B resin melt streams were combined in a combination mass ratio A:B of 50:50 through a melt-spinneret for forming a core-in-sheath type composite yarn having 450 extrusion holes in the form as shown in Fig. 3(a), to form a core-in-sheath type composite resin melt streams, and the resultant core-in-sheath type composite streams were melt-extruded through the spinneret. In this melt-spinning procedure, the spinneret temperature was established at 280°C, and the extrusion rate was established at 150 g/min. Then, the extruded composite filamentary resin melt streams was air cooled with a cooling air flow having a temperature of 30°C at a location 30 mm below the spinneret, and wound at a speed of 1,150 m/min, to provide an undrawn filament yarn. The undrawn filament yarn was drawn at a draw ratio of 3 in hot water at 75°C. An oiling agent comprising 80 parts by mass of potassium salt of

laurylphosphoric acid and 20 parts by mass of polyoxyethylene-modified silicone was imparted in a pickup of the oiling agent of 0.22% by mass to the drawn filament yarn. The oiling agent-applied drawn filament yarn was crimped with plane zigzag type crimps in the number of crimps of 17 crimps/25 mm and a percentage of crimp of 8%, by using a stuffing crimper. The resultant filament yarn was then dried at 105°C for 60 minutes, and cut with a rotary cutter into a fiber length of 5 mm. The resultant staple fibers had a thickness of 1.1 dtex, and had a cross sectional profile as shown in Fig. 3-(A). The test results are shown in Table 1.

Examples 2 and 3 and Comparative Example 1

In each of Examples 2 to 3 and Comparative Example 1, core-in-sheath type composite staple fibers were produced in the same manner as in Example 1 except that the extrusion holes of the spinneret were changed to those having a cross-sectional profiles as shown in Fig. 3-(B), -(C) and -(D). The test results are shown in Table 1.

Comparative Example 2

Core-in-sheath type composite staple fibers were produced under the same conditions as in Example 1, except that the cooling position of the extruded composite filamentary resin melt streams was changed to a location 70 mm below the spinneret. The test results are shown in Table 1.

Example 4

Core-in-sheath type composite staple fibers were produced under the same conditions as in Example 1, except that no stuffing crimper was employed not to impart crimps to the staple fibers. Table 1 shows the test results.

Comparative Example 3

Core-in-sheath type composite staple fibers were produced under the same conditions as in Comparative Example 1, except that no stuffing crimper was used, not

to impart crimps to the staple fibers. Table 1 shows the results.

Examples 5 to 6

In each of Examples 5 and 6, core-in-sheath type composite staple fibers were produced, in the same manner as in Example 1 except that the number of crimps was changed to 5 crimps/25 mm in Example 5 and to 40 crimps/25 mm in Example 6 by controlling the feed rate of the drawn filament yarn to the stuffing crimper and the stuffing pressure to the filament yarn. Table 1 shows the test results.

Example 7 and Comparative Example 4

Core-in-sheath type composite staple fibers were produced in Example 7, in the same manner as in Comparative Example 1, and in Comparative Example 4, in the same manner as in Comparative Example 1, except that the oiling agent-applied, drawn filament yarn was dried at 105°C, moisturized and cut into a fiber length of 0.1 mm by using a Guillotine cutter. The resultant staple fibers of Example 7 and Comparative Example 4 respectively had a water content of 10% by mass. Table 1 shows the test results.

Example 8

Core-in-sheath type composite staple fibers were produced in the same manner as in Example 1 except that the extrusion holes of the spinneret were changed to those having the same cross-sectional profile as in Fig. 3-(C), except that the number of the radial slits was changed to 30. Table 1 shows the test results.

Example 9

Core-in-sheath type composite staple fiber were produced in the same manner as in Example 1 except that the fiber length was changed to 45 mm. Table 1 shows the test results.

Table 1 [Fig. 3]

	Resin core component /sheath component	Cross sectional profile of fiber	Number of concavities	D/L ratio	Thickness (dtex)	Fiber length (mm)
Ex. 1	PET/HDPE	(B) A	3	0.25	1.1	5
Ex. 2	PET/HDPE	" (B) B	1	0.45	1.1	5
Ex. 3	PET/HDPE	" (B) C	8	0.15	1.1	5
Comp.Ex. 1	PET/HDPE	" (B) D	0	-	1.1	5
Comp.Ex. 2	PET/HDPE	" (B) A	3	0.5	1.1	5
Ex. 4	PET/HDPE	" (B) A	3	0.25	1.1	5
Comp.Ex. 3	PET/HDPE	" (B) D	0	-	1.1	5
Ex. 5	PET/HDPE	" (B) A	3	0.25	1.1	5
Ex. 6	PET/HDPE	" (B) A	3	0.25	1.1	5
Ex. 7	PET/HDPE	" (B) A	3	0.25	1.1	0.1
Comp.Ex. 4	PET/HDPE	" (B) D	0	-	1.1	0.1
Ex. 8	PET/HDPE	" -	30	0.25	1.1	5
Ex. 9	PET/HDPE	" (B) A	3	0.25	1.1	45

Table 1 (Continued)

	Number of crimps (crimps/25 mm)	Water content (% by mass)	Number of non-opened fiber bundles (per g)	Number of pills (per g)	Number of defects (per g)
Ex. 1	17	0.7	1	0	1
Ex. 2	17	0.7	1	0	1
Ex. 3	17	0.7	2	0	2
Comp.Ex. 1	17	0.7	20	0	20
Comp.Ex. 2	17	0.7	17	0	17
Ex. 4	0	0.7	2	0	2
Comp.Ex. 3	0	0.7	35	0	35
Ex. 5	5	0.7	3	0	3
Ex. 6	40	0.7	8	0	8
Ex. 7	13	10	7	0	7
Comp.Ex. 4	13	10	90	0	90
Ex. 8	15	0.7	6	0	6
Ex. 9	15	0.7	4	4	8

Note: PET ... Polyethylene terephthalate resin
HDPE ... High density polyethylene resin

Example 10

A poly(ethylene terephthalate) (PET) vacuum dried at 120°C for 16 hours and having an intrinsic viscosity [η] of 0.61 and a T_m of 256°C was melted at a temperature of 280°C and the resultant resin melt was extruded through a melt spinneret having 450 extrusion holes with the form as shown in Fig. 2-(a). The spinneret temperature was controlled to 280°C, and the extrusion rate was controlled to 150 g/min. Moreover, the extruded filamentary resin melt streams were air-cooled by blowing cooling air at 30°C at a location 35 mm below the spinneret, and the resultant filament bundle were wound at a speed of 1,000

test results.

Example 12 and Comparative Example 8

Staple fibers of Example 12 were produced in the same manner as in Example 10, and the staple fibers of Comparative Example 8 were produced in the same manner as in Comparative Example 5, except that the extrusion rate was changed to 100 g/min, the winding speed was changed to 1200 m/min, the draw ratio in the 70°C hot water was changed to 2.85 and the number of crimps was changed to 18 crimps/25 mm. Table 2 shows the test results.

Example 13 and Comparative Example 9

Staple fibers were produced in Example 13 in the same manner as in Example 10 and, in Comparative Example 9 in the same manner as in Comparative Example 5, each except that the extrusion rate was changed to 680 g/min, the winding speed was changed to 900 m/min, the draw ratio in 70°C hot water was changed to 3.4, and the number of crimps was changed to 9 crimps/25 mm. Table 2 shows the test results.

Table 2 [Fig. 2]

	Resin	Cross sectional profile of fiber	Number of recessed portions	D/L ratio	Thickness (dtex)	Fiber length
Ex. 10	PET	(A)	3	0.30	1.0	5
Ex. 11	PET	(B)	1	0.40	1.0	5
Comp.Ex. 5	PET	(C)	0	-	1.0	5
Comp.Ex. 6	PET	(A)	3	0.03	1.0	5
Comp.Ex. 7	PET	(B)	1	0.55	1.0	5
Ex. 12	PET	(A)	3	0.27	0.6	5
Comp.Ex. 8	PET	(C)	0	-	0.6	5
Ex. 13	PET	(A)	3	0.32	4.4	5
Comp.Ex. 9	PET	(C)	0	-	4.4	5

Table 2 (Continued)

	Number of crimps (per 25 mm)	Water content (% by mass)	Number of non-opened fiber bundles (per g)	Number of pills (per g)	Number of defects (per g)
Ex. 10	16	0.7	2	0	2
Ex. 11	15	0.7	2	0	2
Comp.Ex. 5	16	0.7	20	3	23
Comp.Ex. 6	17	0.7	12	2	14
Comp.Ex. 7	12	0.7	12	1	13
Ex. 12	18	0.7	5	2	7
Comp.Ex. 8	18	0.7	45	10	55
Ex. 13	9	0.7	1	0	1
Comp.Ex. 9	9	0.7	11	2	13

Example 14

A low softening point copolymerized poly(ethylene terephthalate isophthalate) (coPET; copolymerized with 40% by mole of isophthalic acid and 4% by mole of diethylene glycol) vacuum dried at 35°C for 48 hours and having an intrinsic viscosity [η] of 0.54 and a T_s of 65°C and a poly(ethylene terephthalate) (PET) vacuum dried at 120°C for 16 hours and having an intrinsic viscosity [η] of 0.61 and a T_m of 256°C were separately melted with separate extruders. The coPET melt having a temperature of 250°C was used for a sheath component (A) and the PET melt having a temperature of 280°C was used for a core component (B). The coPET melt for the sheath component (A) and the PET melt for the core component (B) were extruded in a mass ratio A:B of 50:50 through a melt spinneret for a core-in-sheath type composite fiber having an extrusion holes having the form as shown in Fig. 3-(a), to form core-in-sheath type composite filamentary resin melt streams. In this procedure, the spinneret temperature was controlled to 280°C, and the extrusion rate was controlled to 300 g/min. Moreover, the extruded filamentary resin melt streams were air cooled with a cooling air-blow at 30°C at a location 30 mm below the spinneret, the resultant undrawn filament yarn was wound at a speed of 1,200 m/min. The undrawn filament yarn was drawn at a draw ratio 2.85 in hot water at 70°C, and further drawn at a draw ratio of 1.15 in hot water at 90°C. The drawn filament yarn was oiled with an oiling agent comprising potassium salt of laurylphosphoric acid and polyoxyethylene-modified silicone in a mass ratio of 80:20 in a pickup of the oiling agent of 0.25% by mass. The oiled drawn filament yarn was fed into a stuffing crimper to impart plane zigzag type crimps in a number of crimps of 11 crimps/25 mm at a percentage of crimp of 9%. The

resultant crimped filament yarn was then dried at 55°C for 60 minutes, and cut into a fiber length of 5 mm with a rotary cutter. The resultant staple fibers had a thickness of 1.7 dtex and a cross sectional profile as shown in Fig. 3-(β)[A]. Table 3 shows the test results.

Comparative Example 10

Staple fibers were produced in the same manner as in Example 14 except that the form of the extrusion holes was changed to that shown in Fig. 3-(β)[a]. Table 3 shows the test results.

Example 15

A polyester elastomer (EL) vacuum dried at 35°C for 48 hours, having an intrinsic viscosity [η] of 0.8 and a T_m of 152°C, and comprising hard segments comprising a 15% by mole of isophthalic acid-copolymerized poly(butylene terephthalate) and the soft segments comprising a poly(tetramethylene glycol) having an average molecular weight of 1,500, and a poly(ethylene terephthalate) (PET) dried at 120°C for 16 hours and having an intrinsic viscosity [η] of 0.61 and a T_m of 256°C, were separately melted with separate extruders to provide a EL melt having a temperature of 240°C and a PET melt having a temperature of 280°C. The EL melt was used for sheath component A, and the PET melt was used for a core component B. The EL melt and the PET melt were extruded in a mass ratio A/B = 50/50 through a melt-spinneret having 450 extrusion holes as shown in Fig. 3-(β)[a] for a core-in-sheath type composite fiber, to form core-in-sheath type composite filamentary resin melt streams. In this procedure, while the spinneret temperature was controlled to 280°C, and the extrusion rate was controlled to 310 g/min. Moreover, the extruded filamentary resin melt streams were air cooled with cooling air at 30°C at a location 30 mm below the spinneret, and the resultant undrawn filament yarn was wound at a speed of 1,100

m/min. The resultant undrawn filament yarn was then drawn at a draw ratio of 2.6 in hot water at 70°C, and further drawn at a draw ratio of 1.15 in hot water at 90°C. Then the drawn filament yarn was oiled with a oiling agent comprising potassium salt of laurylphosphoric acid and polyoxyethylene-modified silicone in a mass ratio of 80:20 in a pickup of the oiling agent 0.25% by mass. The oiled filament yarn was fed into a stuffing crimper to impart plane zigzag type crimps at a number of crimps of 8 crimps/25 mm and a percentage of crimp of 6%. The resultant crimped filament yarn was then dried at 70°C for 60 minutes, and cut into a fiber length of 5 mm with a rotary cutter. The resultant staple fibers had a thickness of 2.5 dtex and a cross sectional profile as shown in Fig. 3-(A). Table 3 shows the test results.

Comparative Example 11

Staple fibers were produced in the same manner as in Example 15 except that the extrusion holes of the spinneret were changed to those having a form as shown in Fig. 3-(d). Table 3 shows the test results.

Example 16

A polypropylene (PP) having a MFR of 50 g/10 min and a T_m of 158°C and a poly(ethylene terephthalate) (PET) vacuum dried at 120°C for 16 hours and having an intrinsic viscosity [η] of 0.61 and a T_m of 256°C were separately melted with separate extruders. The PP melt having a temperature of 260°C was used for a sheath component A and the PET melt having a temperature of 280°C was used for a core component (B). The PP melt and the PET melt were fed in a mass ratio A/B of 50:50 to a core-in-sheath type composite spinneret having 450 extrusion holes with a shape as shown in Fig. 3-(a) and extruded through the spinneret to provide core-in-sheath type composite filamentary streams. In this procedure, the spinneret temperature was controlled to 280°C, and the extrusion

rate was controlled to 190 g/min. Moreover, the extruded filamentary resin melt streams were air cooled with a cooling air flow at 30°C at a location 30 mm below the spinneret, and wound the resultant undrawn filament yarn was at a speed of 1,150 m/min. The undrawn filament yarn was drawn at a draw ratio of 2.9 in hot water at 75°C, and then oiled with an oiling agent comprising potassium salt of laurylphosphoric acid and polyoxyethylene-modified silicone in a mass ratio of 80:20 in à pickup of the oiling agent 0.25% by mass. The oiled filament yarn was fed to a stuffing crimper to impart plane zigzag type crimps to the drawn yarn at a number of crimps of 13 crimps/25 mm and a percentage of crimps of 11%. The resultant crimped filament yarn was then dried at 105°C for 60 minutes, and then cut into a fiber length of 5 mm with a rotary cutter. The resultant staple fibers had a thickness of 1.5 dtex and a cross-sectional profile as shown in Fig. 3-(A). Table 3 shows the test results.

Comparative Example 12

Staple fibers were produced in the same manner as in Example 16, except that the extrusion holes of the spinneret were changed to those as shown in Fig. 3-(d). Table 3 shows the test results.

Example 17

A high pressure-processed low density polyethylene (LDPE) having a MFR of 20 g/10 min and a T_m of 113°C and a poly(ethylene terephthalate) (PET) vacuum dried at 120°C for 16 hours and having an intrinsic viscosity [η] of 0.61 and a T_m of 256°C were separately melted with separate extruders, to provide a LDPE melt having a temperature of 250°C and a PET melt having a temperature of 280°C. The LDPE melt was used for a sheath component A and the PET melt was used for a core component B. The LDPE melt and the PET melt were extruded at a mass ratio A/B of 50:50 through a core-in-sheath type composite spinneret having 450 extrusion holes as shown in

Fig. 3-(a) to form core-in-sheath type composite filamentary resin melt streams. In this procedure, the spinneret temperature was 280°C, and the extrusion rate was 200 g/min. Moreover, the extruded filamentary resin melt streams were air cooled with a cooling air flow at 30°C at a location 30 mm below the spinneret, and the resultant undrawn filament yarn was wound at a speed of 1,100 m/min. The undrawn filament yarn was drawn at a draw ratio of 2.8 in hot water at 75°C, and oiled with an oiling agent comprising potassium salt of laurylphosphoric acid and polyoxyethylene-modified silicone at a mass ratio of 80:20 in a pickup of the oiling agent of 0.25% by mass. The oiled filament yarn was fed to a stuffing crimper to impart plane zigzag type crimps to the drawn filament yarn at a number of crimps of 14 crimps/25 mm and in a percentage of crimp of 11%. The resultant filament yarn was then dried at 95°C for 60 minutes, and cut into a fiber length of 5 mm with a rotary cutter. The resultant staple fibers had a thickness of 1.7 dtex and a cross-sectional profile as shown in Fig. 3-(A). Table 3 shows the test results.

Comparative Example 13

Staple fibers were produced in the same manner as in Example 17 except that the extrusion holes of the spinneret were changed to those having a shape as shown in Fig. 3-(d). Table 3 shows the test results.

Example 18

A linear low density polyethylene (LLDPE) having a MFR of 30 g/10 min and a T_m of 122°C and a poly(ethylene terephthalate) (PET) vacuum dried at 120°C for 16 hours and having an intrinsic viscosity [η] of 0.61 and a T_m of 256°C were separately melted with separate extruders, to prepare a LLDPE melt having a temperature of 250°C and a PET melt having a temperature of 280°C, the LLDPE melt was used for a sheath component A and the PET melt was used

for a core component B. The LLDPE melt and the PET melt were extruded in a mass ratio A:B of 50:50 through a core-in-sheath type composite spinneret having 450 extrusion holes, having the form as shown in Fig. 3-(d), to provide core-in-sheath type composite filamentary resin melt streams. In this procedure, the spinneret temperature was 280°C, and the injection amount was 200 g/min. Moreover, the extruded filamentary resin melt streams were air cooled with a cooling air flow at 30°C at a location 30 mm below the spinneret, and the resultant undrawn filament yarns was wound at a speed of 1,100 m/min. The undrawn filament yarn was drawn at a draw ratio of 2.8 in hot water at 75°C and oiled with an oiling agent comprising potassium salt of laurylphosphoric acid and polyoxyethylene-modified silicone in a mass ratio of 80:20 in a pickup of the oiling agent of 0.25% by mass. The oiled filament yarn was fed into a stuffing crimper to impart plane zigzag type crimps to the drawn filament yarn at a number of crimps of 13 crimps/25 mm and at a percentage of crimp of 11%. The resultant yarn was then dried at 95°C for 60 minutes, and cut into a fiber length of 5 mm with a rotary cutter. The resultant staple fibers had a thickness of 1.7 dtex and a cross sectional profile as shown in Fig. 3-(D). Table 3 shows the test results.

Comparative Example 14

Staple fibers were produced in the same manner as in Example 18 except that the extrusion holes of the spinneret were changed to those having a form as shown in Fig. 3-(g). Table 3 shows the test results.

Table 3 [Fig. 3]

	Resin core/sheath	Fiber cross sectional profile	Number of concavities	D/L ratio	Thickness (dtex)	Fiber length
Ex. 14	PET/coPET	(Ø) A	3	0.15	1.7	5
Comp.Ex. 10	PET/coPET	" (Ø) D	0	-	1.7	5
Ex. 15	PET/EL	" (Ø) A	3	0.12	2.5	5
Comp.Ex. 11	PET/EL	" (Ø) D	0	-	2.5	5
Ex. 16	PET/PP	" (Ø) A	3	0.16	1.5	5
Comp.Ex. 12	PET/PP	" (Ø) D	0	-	1.5	5
Ex. 17	PET/LDPE	" (Ø) A	3	0.21	1.7	5
Comp.Ex. 13	PET/LDPE	" (Ø) D	0	-	1.7	5
Ex. 18	PET/LLDPE	" (Ø) A	3	0.20	1.7	5
Comp.Ex. 14	PET/LLDPE	" (Ø) D	0	-	1.7	5

Table 3 (Continued)

	Number of crimps (per 25 mm)	Water content (% by mass)	Number of non-opened fiber bundles (per g)	Number of pills (per g)	Number of defects (per g)
Ex. 14	11	1.3	5	2	7
Comp.Ex. 10	11	1.3	60	15	75
Ex. 15	8	1.5	2	2	4
Comp.Ex. 11	8	1.5	20	7	27
Ex. 16	13	0.3	3	0	3
Comp.Ex. 12	13	0.3	30	3	33
Ex. 17	14	0.7	5	2	7
Comp.Ex. 13	14	0.7	35	10	45
Ex. 18	13	0.7	5	2	7
Comp.Ex. 14	13	0.7	39	11	50

Example 19

A high density polyethylene (HDPE) having a MFR of 20 g/10 min and a T_m of 131°C and a poly(ethylene terephthalate) (PET) vacuum dried at 120°C for 16 hours and having an intrinsic viscosity [η] of 0.61 and a T_m of 256°C were melted separately from each other by separate extruders to prepare a polyethylene melt having a temperature of 250°C and a polyester melt having a temperature of 280°C. The polyethylene melt was used as a sheath component A and the polyester melt was used as a core component B. The sheath component (A) resin melt streams and the core component B resin melt streams were combined in a combination mass ratio A:B of 50:50 through a melt-spinneret for forming a core-in-sheath type composite yarn having 450 extrusion holes in the form as shown in Fig. 3(Ø)[a], to form a core-in-sheath type composite resin melt streams, and the resultant core-in-

sheath type composite streams were melt-extruded through the melt spinneret. In this melt-spinning procedure, the spinneret temperature was established at 280°C, and the extrusion rate was established at 150 g/min. Then, the extruded composite filamentary resin melt streams were air cooled with a cooling air flow having a temperature of 30°C at a location 30 mm below the spinneret, and wound at a speed of 1,150 m/min, to provide an undrawn filament yarn. The undrawn filament yarn was drawn at a draw ratio of 3 in hot water at 75°C. An oiling agent comprising 80 parts by mass of potassium salt of laurylphosphoric acid and 20 parts by mass of polyoxyethylene-modified silicone was imparted in a pickup of the oiling agent of 0.19% by mass to the drawn filament yarn. The oiling agent-applied drawn filament yarn was crimped with plan zigzag type crimps in the number of crimps of 12 crimps/25 mm and a percentage of crimp of 7%, by using a stuffing crimper. The resultant filament yarn was then dried at 105°C for 60 minutes, and then subjected to a procedure in which an aqueous solution of a deodorant functional agent S-100 (trademark, green tea dry distillation extract, made by SHIRAIMATSU SHINYAKU K.K.), in a concentration of 10% by mass was applied to the crimped filament yarn to an extent such that the aqueous solution is picked up in an amount of 1% by mass on the filament yarn (a theoretical pickup of the deodorant functional agent was 0.1% by mass on the basis of the mass of the filament yarn), by using an oiling roller. Then the deodorant-functioned filament yarn was cut with a rotary cutter into a fiber length of 5 mm. The resultant staple fibers had a thickness of 1.1 dtex, and had a cross sectional profile as shown in Fig. 3-(β)A. The test results are shown in Table 4.

Examples 20 and 21 and Comparative Example 15

In each of Examples 20 and 21 and Comparative Example 15, staple fibers were produced in the same

manner as in Example 19, except that the extrusion holes of the spinneret were changed respectively those as shown in Fig. 3-(e)[b], (f)[c] and (g)[d].

The test results are shown in Table 4.

Example 22

Core-in-sheath type composite staple fibers were produced in the same manner as in Example 19 except that the extrusion holes of the spinneret were changed to those having the same cross-sectional profile as in Fig. 3-(f)[c], except that the number of the radial slits was changed to 30. Table 4 shows the test results.

Example 23 and Comparative Example 16

In Example 23 and Comparative Example 16, core-in-sheath type composite staple fibers were produced in the same manner as in Example 19 (for Example 23) and Comparative Example 15 (for Comparative Example 16), except that in place of the deodorant functional agent S-100, a 5% by mass aqueous solution of an antibacterial functional agent, NIKKANON RB (trademark, N-polyoxyethylene-N,N,N-trialkyl ammonium salt) was applied to the crimped filament yarn to an extent such that the aqueous solution of the antibacterial functional agent was picked up in an amount of 5% by mass on the filament yarn (the theoretical pickup of the antibacterial functional agent was 0.25% by mass on the basis of the mass of the filament yarn).

Table 4 shows the test results.

Example 24 and Comparative Example 17

In Example 24 and Comparative Example 17, core-in-sheath type composite staple fibers were produced in the same manner as in Example 19 and Comparative Example 15, respectively, except that in place of the deodorant functional agent S-100, an aqueous emulsion of flame retardant YM88 (trademark, hexabromocyclododecane, made by DAIICHI KOGYO SEIYAKU K.K.) in a concentration of 10% by mass was applied to the crimped filament yarn to an extent such that the aqueous emulsion of the flame

Table 4

[Fig 2]

Item / Example		Resin Core/Sheath	Cross-sectional profile of fiber	Number of concavities	D/L Ratio	Thickness (dtex)	Fiber length (mm)	Type of functional agent	Pick up of functional agent (mass %)	Water content (mass %)	Number of Non-opened fiber bundles (per g)	Number of pills (per g)	Number of defects (per g)
Example	19	PET/HDPE	(B) A	3	0.25	1.1	5	Deodorant	0.1	1.0	3	0	3
	20	PET/HDPE	" (E) B	1	0.45	1.1	5	Deodorant	0.1	1.0	2	0	2
	21	PET/HDPE	" (F) C	8	0.15	1.1	5	Deodorant	0.1	1.0	3	0	3
Comparative Example	15	PET/HDPE	" (B) D	0	-	1.1	5	Deodorant	0.1	1.0	38	0	38
Example	22	PET/HDPE	" (D) A	30	0.25	1.1	5	Deodorant	0.1	1.0	8	0	8
	23	PET/HDPE	" (D) A	3	0.25	1.1	5	Anti-bacterial	0.25	5.0	2	0	2
Comparative Example	16	PET/HDPE	" (D) D	0	-	1.1	5	Anti-bacterial	0.25	5.0	> 100	0	> 100
Example	24	PET/HDPE	" (D) A	3	0.25	1.1	5	Flame retardant	1.0	10.0	8	0	8
Comparative Example	17	PET/HDPE	" (D) D	0	-	1.1	5	Flame retardant	1.0	10.0	> 100	0	> 100
Example	25	PET/HDPE	" (D) A	3	0.25	1.1	5	Vermin-repellent	0.5	5.0	4	0	4
Comparative Example	18	PET/HDPE	" (B) D	0	-	1.1	5	Vermin-repellent	0.5	5.0	> 100	0	> 100
Example	26	PET	" (A)	3	0.30	1.0	5	Deodorant	0.1	1.0	3	0	3
	27	PET	" (B)	1	0.40	1.0	5	Deodorant	0.1	1.0	5	0	5
Comparative Example	19	PET	" (C)	0	-	1.0	5	Deodorant	0.1	1.0	41	0	41